Recommendations for Imaging of Acute Ischemic Stroke: A Scientific Statement From the American Heart Association

An Scientific Statement from the Stroke Council, American Heart Association and American Stroke Association

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Background

- First, new therapies are being developed to treat acute stroke.
- A number of devices have either been approved, or are under evaluation for the performance of intra-arterial mechanical thrombectomy.
- Such an approach (starting with an intra-arterial therapy instead of the administration of an intravenous drug) requires that vascular imaging be performed during the initial imaging assessment of the patient.
Background cont.

- Second, the patient may be triaged for appropriate management with improved imaging techniques beyond a simple CT scan.
- To extend the therapeutic window, improve efficacy, and limit complications, imaging should address 4 essential issues:

  1. the presence of hemorrhage
  2. the presence of an intravascular thrombus that can be treated
     with thrombolytics or aspiration therapy
  3. the presence of hypoperfusion (evident on susceptibility-weighted imaging)
  4. the presence of hypoperfused tissue at risk for subsequent infarction unless adequate perfusion is restored.

Imaging the Cerebral Parenchyma

Recommendations

1. For a patient within a 3-hour time period from onset of symptoms, either NECT or MRI is recommended before intravenous IPA administration to exclude ICH (absolute contraindication) and to determine whether CT hypodensity or MR hypointensity of ischemia is present.
   - Frank hypointensity on CT, particularly if it involves more than one third of the MCA territory, is a strong contraindication to treatment.
   - Early signs of infarct on CT, regardless of their extent, are not a contraindication to treatment. (Class I; LOE: A).

Recommendations cont.

2. For a patient within 3 hours of onset of symptoms, there is a substantial detection rate of subclinical changes with NECT alone, and a more definitive diagnosis will be obtained with MR-DWI or CT-AAS as detailed below if this does not unduly delay the administration of intravenous IPA.
   a) MR-DWI surpasses NECT and other MR sequences for the detection of acute ischemia.
      - The MR sequences accompanying DWI are more effective than CT for excluding some metrics of acute cerebral ischemia, and thus, MRI can be used if it does not undo the timely administration of intravenous IPA. (Class IIa; LOE: B).
Recommendations cont.

b) CTA-SI exceeds NECT and may approach DWI for the detection of large ischemic regions, and although it is less effective for demonstrating small lesions or those in the posterior fossa, it is reasonable to use (Class IIa, LOE: B).

c) A vascular study is probably indicated during the initial imaging evaluation of the acute stroke patient, even if within 3 hours from ictus, to further determine the diagnosis of acute stroke, if such a study does not unduly delay the administration of intravenous tPA and if an endovascular team is available (see “Imaging the Cerebral Vasculature”; Class IIa, LOE: B).

Recommendation cont.

3. For patients beyond 3 hours from onset of symptoms, either MR-DWI or CTA-SI should be performed along with vascular imaging and perfusion studies, particularly if mechanical thrombectomy or intra-arterial thrombolytic therapy is contemplated (Class IIa, LOE: B).

4. Although a gradient-echo MR sequence can be useful during initial evaluation, the presence of MRI-detected cerebral microbleeds, in the absence of unenhanced CT-detected hemorrhage, is not a contraindication to intravenous tPA within 3 hours of stroke onset in patients with a small number of microbleeds (>5) is uncertain (Class IIb, LOE: B).

Recommendations cont.

5. a) CT is recommended for the detection of SAH (Class I, LOE: A)

b) However, if MR is being used to image the patient, the FLAIR sequence can also be used, although there may be some artifacts at the skull base (Class IIa, LOE: B).

6. The MR GRE and FLAIR sequences can be useful instead of CT if intravascular thrombus detection is desired without the use of vascular imaging techniques (Class IIa, LOE: B).
Imaging the Cerebral Vasculature

Recommendations

1. Intracranial Vascular Evaluation

   A. Circle of Willis

   1. Acute large-vessel intracranial thrombus is very accurately detected by CTA, DSA, and MRA. Each of these modalities far surpasses the sensitivity of nonvascular studies such as NECT, FLAIR, or gradient echo MRI, and they are all recommended (Class I, LOE: A).

   2. A vascular study is probably indicated during the initial imaging evaluation of the acute stroke patient within 3 hours of ictus, if such an evaluation does not unduly delay the administration of intravenous rPA, and only if an endovascular team is available to undertake intra-arterial therapy if that is contemplated on the basis of the findings (Class IIa, LOE: B).

Recommendations cont.

3. A vascular study is strongly recommended during the initial imaging evaluation of the acute stroke patient who presents >3 hours after ictus, especially if either intravenous thrombolysis or mechanical thrombectomy is contemplated for management (Class I, LOE: A).

4. For the detection of vascular stenoses and aneurysms, CTA and DSA are recommended (Class I, LOE: A), whereas MRA is less accurate but can be useful (Class IIa, LOE: A).

5. Although TCD can be used as a noninvasive technique to detect vasospasm or stenoses due to spicule cell and other arterial diseases (Class IIa, LOE: A), CTA and DSA are more accurate in determining the degree of stenosis and should be used for definitive diagnosis (Class I, LOE: A).

   - MRA is less accurate for such assessment than CTA and DSA but can be useful (Class IIa, LOE: A).
Recommendations cont.

II. Extracranial Vascular Evaluation

A. Evaluation of the extracranial vasculature by ultrasound alone should not be done for assessment of occlusive disease if surgical (CEA) or endovascular (arterial angioplasty and stenting) therapy is contemplated (Class IIa, LOE: A).

B. For evaluation of the degree of stenosis and for determination of patient eligibility for CEA or carotid angioplasty and stenting:

1. DSA is the recommended imaging modality to determine the degree of stenosis (Class I, LOE: A).

2. Two noninvasive techniques (among ultrasound, CTA, and MRA) can be used, although with less accuracy with regard to the degree of stenosis than DSA alone, which thus may increase the chance of inappropriate therapy (Class IIa, LOE: B).

II. Extracranial Vascular Evaluation

B. For evaluation of the degree of stenosis and for determination of patient eligibility for CEA or carotid angioplasty and stenting:

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2. Two noninvasive techniques (among ultrasound, CTA, and MRA) can be used, although with less accuracy with regard to the degree of stenosis than DSA alone, which thus may increase the chance of inappropriate therapy (Class IIa, LOE: B).
Recommendations cont.

C. Although CTA (in the absence of heavy calcifications) and MRA are highly accurate for detecting dissection (CTA likely greater than MRA), DSA remains the gold standard and should be used for definitive diagnosis (Class I, LOE: A).

D. A very-high-grade stenosis (string sign) is most accurately detected by DSA, followed closely by CTA.
  - Either can be useful (Class IIa, LOE: B).

Imaging of Cerebral Perfusion

Recommendations

Perfusion-Derived Values

- Quantitative thresholds of tissue that is dead or destined to die versus tissue that is still living and may be salvageable are the goal of all perfusion techniques.

- Although the performance of such studies may be considered to identify and differentiate the ischemic penumbra and intact core, their accuracy and usefulness have not been well established (Class IIb, LOE: B).

Clinical Role of Perfusion Imaging

1. The admission volumes of intact core and ischemic penumbra may be significant predictors of clinical outcome, possibly exceeding the prognostic value of admission NIHSS score (Class III, LOE: B).
Recommendations cont.

2. There is increasing but as yet indirect evidence that even relatively imprecise measures of core/penumbra mismatch may be used to select patients for treatment beyond a strict 3-hour time window for intravenous thrombolysis.

• Together with vascular imaging, these approaches may determine suitability for other therapies such as mechanical clot retrieval and intra-arterial thrombolysis, as well as provide a surrogate marker for treatment efficacy (Class IIb, LOE: B).